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# Description

# SPIN-ON DESICCANT CARTRIDGE WITH INTEGRAL OIL REMOVAL FILTER

## CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of United States Patent Application Serial No. 10/205,795 filed July 26, 2002, the entire disclosure of which is hereby incorporated by reference.

## BACKGROUND OF INVENTION

[0002] This invention relates to a compressed air system, and specifically an air dryer assembly for the compressed air system that removes moisture and oil. The invention finds particular application in a compressor system for vehicles that use pressurized air to selectively control application of vehicle brakes and for other air operated systems associated with the vehicle.

[0003] Compressed air systems are used in conventional brake systems, for example, to provide and maintain air under pressure to operate vehicle brakes and auxiliary air sys-

tems. Water, particulates, and oil in the compressed air system can lead to component degradation and interfere with optimal operation of the system. Accordingly, an air dryer is usually incorporated into the system to remove water from the compressed air. The air dryer collects and removes air system contaminants in solid, liquid, and vapor form before the contaminants enter the system. The air dryer delivers clean, dry air for braking system components, thereby increasing system life and reducing maintenance costs.

[0004] An air brake compressor is typically supplied with oil from the vehicle engine in order to lubricate bearings and other components of the compressor. As will be appreciated, it is difficult to contain the oil in the compressor and oil occasionally becomes entrained in the pressurized air stream exiting the compressor. Modern air dryers use a desiccant material to adsorb water vapor as it passes through an air line from the compressor toward a reservoir or downstream components. The operation and efficiency of the desiccant is adversely affected by oil and thus it is important to minimize contamination of the desiccant with oil by employing a filtering element or oil filter that effectively removes the oil.

[0005] In addition, commercially available desiccant-type air dryers provide a structure that allows for replacement of the desiccant material. Periodic replacement of the desiccant material is desirable since, in use, the desiccant material becomes coated with contaminants such as oil, which ultimately reduces its water vapor retention characteristics. Since other components of air dryers have a longer service life, a convenient system for selectively replacing the desiccant material is desired. For example, a spin-on type desiccant air dryer cartridge resembles a conventional motor vehicle spin-on oil filter in the form of a canister. A load plate has a centrally threaded bore such that the entire replaceable air cartridge unit is threaded onto an upstanding boss extending from a mounting surface of the vehicle.

[0006] An oil coalescing element removes a majority of aerosols and liquid oil entering a spin-on desiccant cartridge. Unfortunately, known designs have not adequately addressed removal of coalesced oil from the cartridge. For example, purge flow systems direct air flow in a reverse direction or back through the oil coalescing element in an effort to remove entrained oil from the desiccant. However, a poor design can lead to desiccant leakage, to a re-

duction in the removal of oil from the cartridge, thus leading to a decrease in desiccant life, and ultimately to a negative impact on the performance of the compressed air system.

[0007] Thus, a continued need exists in the art to effectively eliminate desiccant contaminant in an air dryer assembly of a compressed air system, to remove the contaminant from the dryer assembly, and to contain the desiccant.

## SUMMARY OF INVENTION

[0008] An improved air dryer assembly for removing moisture and oil from a compressed air system is provided that meets the above needs and others in a simple and economical manner.

[0009] More particularly, an exemplary embodiment of the invention includes a desiccant material received in a shell for removing moisture as compressed air passes therethrough. An inlet is disposed upstream of the desiccant material, and an outlet disposed downstream thereof. A coalescing element is disposed in the inlet and has a coalescing material for removing at least oil aerosols from the compressed air. A check valve is located in parallel with the coalescing element inlet. The check valve forces compressed air to pass through the coalescing element as

air flows from the inlet to the outlet, and allows compressed air to bypass the coalescing element as purge air flows from the outlet to the inlet.

[0010] In one embodiment of the present invention, a support member advantageously retains the coalescing element and check valve in the shell.

[0011] In another embodiment, a biasing assembly exerts a compacting force on the desiccant material in the shell.

[0012] Another aspect of the present invention is a method of removing oil aerosols and liquid oil from the cartridge is also provided. The method includes the steps of directing incoming air through the coalescing element and bypassing the coalescing element during a reverse purge flow.

[0013] Further advantages and benefits of the invention will become apparent to those skilled in the art after considering the following description and appended claims in conjunction with the accompanying drawings.

## Brief Description of Drawings

[0014] The invention may take physical form in certain parts and arrangements of parts, a preferred embodiment of which will be described in detail in the following specification.

[0015] FIGURE 1 is a longitudinal cross-sectional view of a spin-on desiccant cartridge in accordance with the present in-

vention.

[0016] FIGURE 2 is a longitudinal cross-sectional view of another preferred embodiment of a spin-on desiccant cartridge.

## DETAILED DESCRIPTION

[0017] An air dryer formed in accordance with the present invention is shown in FIGURE 1 and is generally designated by reference numeral *10*. It will be appreciated that other components of the air dryer assembly are generally well known in the art, for example as shown and described in U.S. Patent No. 5,622,544, the disclosure of which are incorporated herein by reference, so that further discussion herein is deemed unnecessary. The spin-on cartridge of the present invention includes a first or outer shell *12* that is preferably cup-shaped. That is, a first or closed end *14* forms a dome while a second or open end *16* is sealingly secured to a load plate *20*. The load plate includes an inlet *22* that allows pressurized air from a compressor (not shown) to pass through the cartridge where contaminants and moisture are removed from the air stream. A second passage or outlet *24* is also formed in the load plate *20* and in one embodiment is located at a central location. The outlet *24* communicates with downstream components, such as a storage reservoir (not shown) where clean

dry pressurized air is maintained until required by the compressed air system.

[0018] A second or inner shell *30* encloses a desiccant material represented by beads *34*. The inner shell includes a central wall or cylindrical member portion *32* that extends outwardly from one face of a support wall portion *36*. The support wall has a series of openings *38* that are dimensioned to allow air to flow into the desiccant bed. Extending from an opposite face of the support wall portion is a support annulus portion *39*. In addition to a downturned flange *40* along the periphery of the support wall portion *36*, the annulus portion *39* locates the inner shell *30* within the outer shell *12* of the cartridge assembly *10*.

[0019] The desiccant material *34* preferably fills the cavity or space between the inner shell *30* and outer shell*12*. That is, the desiccant material *34* is received within the inner shell *30* and fills the annular gap between the cylindrical wall portion *32* and the outer shell *12*. A perforated material or cloth *50* is air permeable and serves to retain the desiccant material above the support wall portion *36* in a manner that is generally conventional so that further discussion regarding the structure and operation of the cloth *50* and perforated support wall is deemed unnecessary.

[0020] A biasing member, such as spring *52*, exerts a compacting force on the desiccant bed. In this embodiment, the spring *52* engages the annular wall portion *39* and urges the inner shell *30* toward the closed end *14* of the outer shell *12*. An opposite end of the spring *52* engages an inner support member portion *60* along an inner ledge portion *62* that sealingly engages the load plate *20* around the outlet *24*. The inner support member portion *60* extends from the load plate *20* and includes a radial wall portion *64* that terminates along its periphery in an axially extending groove *66*. The groove *66* retains a first or upper end of a coalescing layer or element *70*. The coalescing layer *70* is preferably a micro-glass fiber or spun glass material that has the consistency of matting or felt. The coalescing layer *70* entraps or coalesces oil or oil aerosols as air passes therethrough from the inlet *22* before entering the desiccant bed. In one embodiment, the upper end *72* of the coalescing element *70* is received in the inner support member *60*, while a second or low end *74* is spaced from the load plate *20*. This forms a radial passage *80* that is selectively open to airflow as will become more apparent below.

[0021] A wicking material *82*, such as an open-pored polyester

material, envelops or surrounds the coalescing element *70* and passage *80*. As shown in FIGURE 1, the wicking element *82* extends across the entire gap defined between the annular groove *66* and the inner support member *60* and the load plate *20*. The wicking material *82* has a porous construction which allows air to flow through the wicking element *82* and serves to draw oil that coalesces in coalescing element *70* for deposition in a recessed region *84* disposed radially between the wicking element *82* and the outer shell *12*.

[0022] A one-way flow control device or check valve *90* is associated with the purge outlet passage *80*. The check valve precludes airflow from the inlet *22* into the purge outlet. In this manner, all incoming flow must pass through coalescing element *70* before reaching the desiccant bed. On the other hand, the check valve *90* freely opens when a reverse or purge flow is provided. As is known in the art, the reverse or purge flow is periodically passed through the desiccant bed to regenerate the desiccant material and carry adsorbed moisture out of the system, i.e., purge the collected contaminants and moisture. By locating the check valve *90* in parallel arrangement with the coalescing element *70*, airflow will travel from the inlet *22* to the out-

let *24* through the coalescing element *70*, while the purge flow allows airflow to pass through the check valve *90* as it migrates from the outlet *24* to the inlet *22*. This flowpath allows the purged air to bypass the coalescing element *70* in its purge path, while picking up coalesced oil that is temporarily collected in the region *84*. This oil can migrate through the wicking element *82* and out through the check valve *90*, where it communicates with the external environment, atmosphere, or other desired location. In this manner, oil laden air passes through the coalescing element *70* for removal of oil and oil vapor, yet allows purge airflow to remove the coalesced oil without flowing back through the element.

[0023] FIGURE 2 is another embodiment of the invention illustrating various changes that can be adopted while incorporating the inventive concepts of the present invention. For purposes of brevity, and ease of understanding, like reference numerals with a primed (') suffix refer to like elements and new numerals refer to new components. Particularly, outer shell *12'* receives an inner shell *30'* which is slightly modified to incorporate an outer, generally cylindrical wall *92* that is closed at a first or upper end by a compression plate *94*. The compression plate *94* allows the

biasing spring *52'* to be positioned between the closed end *14'* of the outer housing and the desiccant bed *34'* held within the inner shell *32'*.

[0024] In addition, the lower wall portion *36'* of the inner shell has a conical central portion *96* that maximizes the volume of desiccant material received in the inner shell *32'*. It will also be appreciated that the perforated cloth material *50'* retains the desiccant beads within the inner shell *32'* and prevents the beads from passing through openings *38'* in the support wall portion *36'*. Here, the support wall portion *36'* is defined by two portions, an outer annular portion disposed between walls *32'* and *92* and an inner portion dimensioned for receipt at the base of the truncated conical wall *96*.

[0025] As will be appreciated, the coalescing element *70'* is still disposed in parallel relation with the purge outlet *80'* and check valve *90'* so that air flowing from the inlet *22'* to the outlet *24'* must proceed through the coalescing element *70'*. On the other hand, the reverse, purge flow from the outlet *24'* to the inlet *22'* is able to bypass the coalescing element *70'* and remove oil collected in the region *84'* through the check valve *90'* from the cartridge.

[0026] The invention has been described with reference to illus-

trative embodiments. Obviously, modifications and alterations will occur to others upon a reading and understanding of the preceding detailed description. For example, the cartridge may not be a spin-on type of cartridge, or may adopt a wide variety of other structural configurations, materials of construction, flow paths therethrough without departing from the spirit and scope of the invention described herein. The invention is to be construed as including all such alterations and modifications insofar as they come within the scope of the appended claims or the equivalents thereof.